

Claims Listing

Claim 1 (canceled): An atmospheric pressure chemical vapor deposition furnace for depositing thin films on a workpiece at a temperature of 1200° C and above comprising:

a process chamber comprising a reflective interior surface for containing and reflecting heat back to heating elements, including means for actively cooling the process chamber surface such that a thermal response of the furnace is determined solely by thermal mass of the heating elements;

a plurality of linear heating elements disposed in one or more planar arrays within the process chamber and in proximity to the workpiece such that temperature difference (DT) between the workpiece and heating elements is minimized and the heating elements, with the reflective heat containment of the process chamber, approximate an isothermal chamber.

Claim 2 (currently amended): An atmospheric pressure comprising:

an aluminum process chamber having ~~an exterior surface~~
opposing sides defining an entrance and an exit and polished
interior ~~surfaces~~ walls;

a plenum provided adjacent the opposing sides of the process chamber for receiving a flow of inert gas such as Argon ;

aluminum rails provided on interior walls of the process chamber,
for slideably transporting one or more workpieces from the
entrance of the process chamber to the exit for continuous
processing.

~~one or more~~ a plurality of elongated heating elements, extending
through apertures in the process chamber ~~to the exterior surface~~
into each plenum, said heating elements arranged in a planar array
with respect to the workpiece, each heating element comprising an
aluminum chromium iron alloy resistive wire commonly known as
Kanthal, ~~resistive wires protected by~~ enclosed in a respective
alumina ceramic tubing sleeve such that the workpiece is protected
from contamination by the heating elements at high temperatures
and the heating elements are protected from contamination by the
workpiece ; and ~~said resistive wires extending longitudinally~~
~~through the ceramic tubing such that the wires freely expand and~~
~~contract in response to temperature changes~~

cooling channels disposed in the walls ~~exterior surface~~ of the
process chamber. ~~and,~~

~~aluminum rails provided on interior surfaces of the process~~
~~chamber, said rails positioned to slideably transport one or more~~
~~workpieces from a receiving end of the process chamber to an exit~~
~~end for continuous processing.~~

Claim 3 (canceled): An atmospheric pressure furnace comprising:

a process chamber having highly polished interior surfaces defining an entrance, an exit and a processing region for a workpiece;

rails provided on opposed interior surfaces of the process chamber, said rails positioned for supporting a workpiece along an axis of travel from the entrance, through the processing region, and to the exit of the process chamber;

a first array of parallel, closely-spaced, elongated heating elements positioned below the rails;

a second array of parallel, closely-spaced, elongated heating elements positioned above the rails, wherein said first and second arrays of heating elements comprise resistive wires protected by ceramic tubing and the ends of the heating elements extend through apertures in the process chamber and are held in an external mounting structure for connection to an electric current; and

cooling channels disposed in the exterior surface of the process chamber.

Claim 4 (canceled): A process chamber as in claim 3 wherein the process chamber comprises aluminum having highly polished interior surfaces for reflecting heat back to the processing region such that the temperature difference between the heating elements and the workpiece is minimized.

Claim 5 (canceled): A furnace as in claim 3 wherein the polished interior surfaces are plated with gold.

Claim 6 (canceled): A furnace as in claim 3 wherein the rails are made of aluminum.

Claim 7 (canceled): A furnace as in claim 3 wherein the rails are made of molybdenum.

Claim 8 (canceled): A furnace as in claim 3 wherein the resistive wires in each heating element extend longitudinally through the ceramic tubing such that the wires are free to expand and contract in response to temperature changes.

Claim 9 (canceled): A furnace as in claim 3 wherein each heating element is a modular unit adapted for individual replacement without removing other heating elements.

Claim 10 (canceled): A furnace as in claim 3 wherein the electrical connection to each heating element is made via threaded metal terminals incorporating short transverse rods that conformably engage recesses in the mounting structure to prevent inadvertent torque from causing damage to wires of the heating element.

Claim 11 (canceled): A furnace as in claim 3 further comprising gas purge structures at the entrance and exit of the process chamber that prevent air from entering the process chamber while allowing

the workpiece to pass through, thus enabling high-throughput processing.

Claim 12 (canceled): A furnace as in claim 3 further comprising a thermal controller that can change the temperature in the process chamber from one temperature to another within a range of 800 - 1400 C in less than 30 minutes.

Claim 13 (canceled): A furnace as in claim 3 further comprising a thermal controller which can cause the temperature in the process chamber to be cooled from more than about 1200 C to less than 800 C in less than 30 minutes.

Claim 14 (canceled): A furnace comprising:

a process chamber comprising polished aluminum walls; and

one or more heating elements provided inside the chamber in direct proximity to a workpiece, the ends of the heating elements extending through apertures in the aluminum walls for receiving an electric current, such that the temperature of the heating elements and the workpiece exceed the melting temperature of the process chamber for more than 30 minutes during furnace operation.

Claim 15 (canceled): A furnace as in claim 14 further comprising highly polished interior surfaces defining the process chamber for the purpose of reflecting heat upon a workpiece; and

cooling channels conformably disposed in the exterior surfaces of the walls for removing non-reflected heat, such that the reflectivity of the polished interior surfaces does not decrease as the process temperature of the furnace increases.

Claim 16 (newly added): An atmospheric pressure furnace as in claim 2 wherein the heating elements further comprise a surface layer of aluminum oxide on the resistive wires that is compatible with the alumina ceramic sleeve, such that heating element service temperatures up to 1400 degrees C are maintained without contamination of the workpiece or deterioration of the heating elements.

Claim 17 (newly added): An atmospheric pressure furnace as in claim 2 further comprising first and second planar arrays of heating elements spaced about three eighths inch (0.375) apart, the arrays disposed above and beneath the workpiece such that the workpiece is surrounded by a substantially uniform heating surface approximating an isothermal chamber.

Claim 18 (newly added): An atmospheric pressure furnace as in claim 2 comprising a ΔT (actual heating element temperature minus workpiece temperature) that is in a range of 100° C or less.

Claim 19 (newly added): A heating element for preventing contamination of a workpiece in a furnace including aluminum walls defining a reflective process chamber comprising:

a first resistive wire having a first diameter comprising an alloy of aluminum chromium and iron commonly known as Kanthal encased in a supporting aluminum ceramic sleeve located within the process chamber and supported at a terminal end in a wall of the furnace ;

a Nichrome wire welded to the first resistive wire having a second diameter larger than the first diameter for providing a transition zone to reduce heating from the first wire;

a nickel wire welded to the Nichrome for further reducing heat to the supporting terminal.